Instruction Manual 0101-8871-2

L&SP 4854

AIRCO Temescal

Model MC-4B
SCR SPEED CONTROL

(Part Number 0505-0190-0)

MP MASTER
MA32752

Airco Temescal, a Division of Airco, Inc.

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FIGURES AND DRAWINGS

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Terms and Conditions

MECHANICAL WARRANTY: For a period of twelve (12) months from the date of original shipment to Purchaser thereof, the apparatus and each part or component manufactured by the Airco Temescal Division of Airco, Inc. ("Airco") is warranted to be free from functional defects in materials and workmanship. The foregoing warranty is subject to the condition that the apparatus, part or component be properly operated under conditions of normal use and that regular periodic maintenance and service be performed or replacements made in accordance with instructions provided by Airco. The foregoing warranty shall not apply to any apparatus, part or component that has been repaired other than by Airco or an authorized Airco representative or in accordance with written instructions provided by Airco, that has been altered by anyone other than Airco or that has been subject to improper installation or abuse, misuse, negligence, accident or corrosion.

Purchaser's sole and exclusive remedy under the above warranty is limited to, at Airco's option, repair or replacement of defective parts or components or return to Purchaser of the price of the apparatus. Any such obligation on Airco's part is subject to the following requirements: (x) the defect must be promptly reported to Airco; (y) if so advised by Airco, Purchaser must return the part or component with a statement of the observed deficiency not later than seven (7) days after the expiration date of the warranty to the address designated by Airco, during normal business hours, transportation charges prepaid; and (z) upon examination by Airco, the part or component must be found not to comply with the above warranty. Return trip transportation charges for the part or component shall be paid by Purchaser. In the event that Airco elects to refund the purchase price, the apparatus shall be the property of Airco and shall be promptly shipped to Airco at Airco's expense. This Mechanical Warranty shall be void and the apparatus shall be deemed to be purchased AS IS in the event that the entire purchase price has not been paid within thirty (30) days of original shipment of the apparatus.

THERE ARE NO EXPRESS OR IMPLIED WARRANTIES THAT EXTEND BEYOND THE WARRANTY HEREINABOVE SET FORTH. THERE IS NO WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE WITH RESPECT TO THE APPARATUS OR ANY PART OR COMPONENT THEREOF AND NO WARRANTY SHALL BE IMPLIED BY LAW.

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PERFORMANCE WARRANTY: Airco warrants that the apparatus will comply with the specifications set forth in the purchase order. All specifications are subject to the corrections and tolerances allowed by the NEC. If the purchase order expressly provides for factory testing to verify compliance with the specifications, the Purchaser shall be entitled to witness the testing and the results of the testing. Upon demonstration of compliance with the specifications by factory testing, Airco's liability for failure to comply with the specifications shall terminate. In the event that the purchase order does not describe a comprehensive test program for demonstration of compliance with the specifications, Airco's test program (which may incorporate extrapolation of data or test results based upon similarity of criteria established by Airco) shall be used for such purpose.

If the purchase order does not expressly provide for factory testing, compliance with the specifications shall be demonstrated by field testing which shall be conducted by Purchaser at Purchaser's expense. Airco shall have the right to: (a) witness the field testing and to verify the results of such field testing; (b) have free access to all data compiled by the Purchaser in connection with any field test; and (c) conduct its own field test at its own expense during any 14-day consecutive period which may be mutually agreed upon by Airco and the Purchaser; provided, however, that Airco shall have the right to field test within six months of receipt from the Purchaser of any notice of failure to comply with the specifications. If compliance with the specifications is to be demonstrated by field testing, the Purchaser shall conduct and complete all field testing within sixty (60) days of the original shipment of the apparatus and shall promptly notify Airco of any failure to comply with the specifications. Airco shall not be liable for any failure to comply with the specifications demonstrated by field testing unless it receives notice thereof within sixty-seven (67) days of the date of original shipment of the apparatus.

In the event that factory testing or field testing does not demonstrate compliance with the specifications, the Purchaser's sole and exclusive remedy under the above warranty is limited to, at Airco's option, repair or replacement of defective parts or components or return to the Purchaser of the purchase price of the apparatus. In the event that Airco elects to refund the purchase price, the apparatus shall be the property of Airco.

Any obligations on Airco's part under this Performance Warranty are subject to the following re-

quirements: (x) the nature of the failure of the apparatus to comply with the specifications must be promptly reported to Airco in writing; (y) if the apparatus has been delivered and field tested, the Purchaser must return the apparatus or any part or component to Airco upon its request, not later than sixty-seven (67) days after initial shipment to Purchaser, to the address designated by Airco, during normal business hours, transportation charges prepaid; and (z) upon examination and testing by Airco, the apparatus must be found not to comply with the specifications. Return trip transportation charges for the apparatus or any part or component shall be paid by the Purchaser. This Performance Warranty shall be void and the apparatus shall be deemed to be purchased AS IS in the event that the entire purchase price has not been paid within thirty (30) days of original shipment of the apparatus.

THERE ARE NO EXPRESS OR IMPLIED WARRANTIES THAT EXTEND BEYOND THE WARRANTY HEREINABOVE SET FORTH. THERE IS NO WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE WITH RESPECT TO THE APPARATUS OR ANY PART OR COMPONENT THEREOF AND NO WARRANTY SHALL BE IMPLIED BY LAW.

DISCLAIMER OF LIABILITY: IN NO EVENT SHALL AIRCO BE LIABLE FOR DIRECT, INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, ARISING FROM ANY SOURCE such as, but not limited to, the manufacture, use, delivery (including late delivery) or transportation of any apparatus, part or component sold to Purchaser, whether such damages are caused by Airco's negligence or otherwise. Without limiting the generality of the foregoing sentence, Airco shall not be liable for: the cost of capital; the cost of substitute apparatus, services, repairs, components or parts; loss of profit or revenue; the cost of power whether purchased or produced by the consumer thereof; loss of use of the apparatus or any part thereof, or any other property owned by Purchaser; claims or costs of Purchaser's customers; injury to persons or death; or damages to any property. In the event that any limited warranty or disclaimer of liability is found to be unlawful or inapplicable, or to have failed of its essential purpose, Airco's liability shall be limited to the amount paid by Purchaser for the apparatus.

USER RESPONSIBILITY

This equipment will perform in accordance with the instructions and information contained in this manual, and its referenced documents, when such equipment is installed, operated, and maintained in compliance with such instructions. The equipment must be checked periodically. Defective equipment shall not be used. Parts that are broken, missing, plainly worn, distorted, or contaminated, shall be replaced immediately. Should such repair or replacement become necessary, Airco recommends that a telephonic or written request for service be made to Airco Temescal.

The equipment, or any of its parts, shall not be altered without the prior written approval of Airco Temescal. The user and/or purchaser of this equipment shall have the sole responsibility for any malfunction which results from improper use, faulty maintenance, damage, improper repair, or alteration by any party other than Airco Temescal.

SAFETY INSTRUCTIONS FOR OPERATING AND MAINTENANCE PERSONNEL

DANGER: HIGH VOLTAGE!!

1. Before servicing or operating this equipment, read all the component manuals supplied with the system, paying special attention to any safety precautions.

2. Before servicing this equipment, disconnect the electrical power at the main power switch. This switch should have a lock out feature. Lock the power off and keep the key with you while working on the equipment.

3. Before entering any service area, use the special grounding hook (provided) to short out all voltages from the various high voltage parts and conductors.

4. Certain electrical components (e.g. electrolytic condensers) hold a lethal voltage even after the main power is turned off. BE SURE such components have been discharged by shorting the B+ terminals to ground before starting any repairs.

5. Be sure the equipment is connected to a power receptacle having the correct polarity and grounding as prescribed by the National Electrical Code. Refer to the power supply section of the instructions to determine the proper electrical ground.

6. DO NOT TOUCH high voltage leads such as filament leads to the electron beam gun or the secondary of the filament transformers.

7. This equipment contains electrical interlocks to protect personnel from injury. DO NOT DEFEAT, OVERRIDE, OR BYPASS THESE PROTECTIVE DEVICES!! Never leave the keylock in the "SERVICE" position. This is a service only position and bypasses the safety interlock system. Normal operation requires the keylock to be in the "AUTO" or "MANUAL" position.

8. DO NOT WORK ALONE!

9. Wear safety glasses.

10. Operators shall not enter areas of the equipment intended for service access only. Only experienced service personnel should enter such areas AFTER taking the various precautions described above.

11. POST HIGH VOLTAGE WARNING SIGNS conspicuously in the operating area.

12. Remove rings, watches, and bracelets before working around high voltage.

SECTION 1

SPECIFICATIONS

1.1 INTRODUCTION

The Model MC-4B silicon controlled rectifier (SCR) speed control unit performs two basic functions: (1) it adjusts and maintains the motor speed, and (2) it provides current-limit overload protection for the motor.

1.2 EQUIPMENT SUPPLIED

1 SCR speed control Model MC-4B

1 plug, Cinch-Jones P-304-CCT

1 plug, Winchester MRAC-14P with solder pins

2 instruction manuals

1.3 INPUT REQUIREMENTS

115-volt ac, single-phase, 50/60 hertz, 1 ampere, 3-wire (third-wire building ground)

1.4 OUTPUT SPECIFICATIONS

a) Motor speed adjustable range

maximum: 100% of rated speed

minimum: 20% of rated speed

NOTE

The internal potentiometer R2 can be adjusted so that the front panel SPEED ADJUST potentiometer (R3) will stop the motor when it is turned fully counterclockwise. If this adjustment is made, however, there may be a deadband as R3 is turned clockwise, until the motor suddenly starts rotating at about 15% of the rated speed.

1.4 (continued)

b) Output voltage: 550 volts maximum peak voltage

c) Output voltage waveform: rectified halfwave, silicon controlled rectifier chopped

d) Output voltage ripple: 100%

e) Output voltage ripple frequency: 60 hertz

f) Overload current trip

level: adjustable by potentiometer

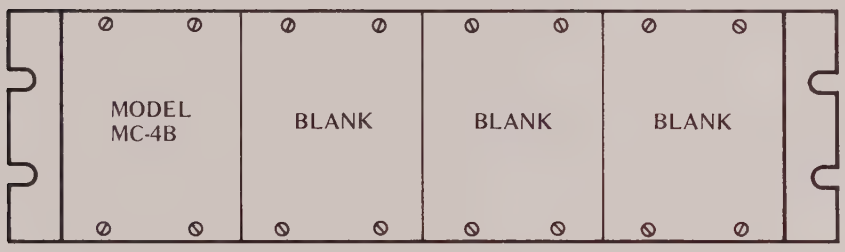
speed: time-delayed

g) Motor: Use a Bodine Electric Company, Catalog No. B2l50E-18, or equivalent shunt-wound motor with the MC-4B. This 115-volt direct current motor draws 0.090 amperes armature current at no load and 0.180 amperes at rated torque. The filled winding draws 0.100 amperes. The motor decrease, including slippage, is 190 milliamperes. The trip point is 250 milliamperes.

h) Leads: Leads from the rear panel MOTOR output plug to the motor armature winding should have 0.300 amperes capacity direct current or 6 amperes peak halfwave, 60 hertz current. The leads should be a twisted pair so that their distributed capacitance is sufficient to bypass very high frequency transients induced at the motor or in the motor leads by external circuitry. The field leads should be capable of 0.150 amperes.

1.5 TYPICAL MOUNTING CONFIGURATION FOR MODEL MC-4B SILICON CONTROLLED RECTIFIER SPEED CONTROL

As an option, the Model MC-4B silicon controlled rectifier speed control unit can be used in conjunction with a module case (Airco Temescal part 0411-6183-2). The case (5-7/32 x 19 inches) enables mounting in a standard 19-inch rack that can accommodate up to four units, as illustrated. Blank panels are also available from Airco Temescal (quarter panel, 0411-6173-2; half panel, 0411-6283-2).



SECTION 2

CONTROLS AND INDICATORS

2.1 FRONT PANEL (Figure 1a)

a) LOCAL/OFF/REMOTE: This double-pole, double-throw, center-off toggle switch applies power to the circuit when the switch is in either the LOCAL or the REMOTE position. In the REMOTE position, the normally closed contacts of relay K1-2 can be used to externally indicate an overload condition. The switch also resets the overload current-limit silicon controlled rectifier.

b) SPEED ADJUST: Turning this control clockwise increases the motor speed and turning it counterclockwise decreases the motor speed. The control is recessed and must be adjusted with a screwdriver.

c) FWD/REV: This double-pole, double-throw, spring-loaded toggle switch reverses the direction of current flow in the motor armature. When the switch is released, the circuit returns to the forward direction.

d) OVERLOAD: This indicator (DS2) illuminates after the motor overload protection silicon controlled rectifier has fired, which occurs when the safe current level for the motor is exceeded. The overload protection is reset by moving the LOCAL/OFF/REMOTE switch to the OFF position for a few seconds.

e) RUNNING: This indicator (DS1) illuminates when power is applied to the unit in either the LOCAL or the REMOTE position.

2.2 REAR PANEL (Figure 1b)

a) 1 ampere SLOBLO fuse, 3Ag

b) MOTOR: This plug provides the output drive voltage to the motor armature and field windings.

CAUTION

Do not parallel the motor field winding with the motor armature winding, or the MC-4B unit could be damaged.

2.2 (continued)

c) POWER: This plug furnishes 115 volts ac input power to the MC-4B and also provides an external remote on/off and an external spare interlocking network.

2.3 CHASSIS ASSEMBLY (Figure 1c)

a) OVERLOAD RELAY: When the overload curve (figure 1c) is exceeded, this relay operates to disable the silicon controlled rectifier firing circuit.

b) LOAD SCR: The firing of this silicon controlled rectifier (CR 4) controls the speed of the motor.

c) FEEDBACK BLOCKING DIODE: This diode isolates the back electromotive force of the motor from the power source during the off period.

d) FULLWAVE BRIDGE: 1.5 amperes, 600 volt bridge rectifier.

e) TRANSFORMER: 117 volts, primary; 82 volts 0.15 amperes, and 332 volts, 0.2 amperes, secondary.

f) POTENTIOMETER: 2,000, 20-turn trim potentiometer. This potentiometer (R21) is used to set the operating point of the overload circuit.

g) POTENTIOMETER: 5,000, 20-turn trim potentiometer. This potentiometer (R2) is used to set the minimum speed of the motor.

h) POTENTIOMETER: 200,000, 20-turn trim potentiometer. This potentiometer (R14) is used to set the maximum speed of the motor.

SECTION 3

INSTALLATION AND START-UP PROCEDURE

3.1 INSTALLATION CHECKLIST

a) Inspect the MC-4B for damage or denting that may have occurred during shipment. Report any such problems immediately to the transportation company.

b) See that the proper motor is being used, as specified in section 1.4.g.

c) Make sure the motor leads are properly connected for correct polarity, by turning on the motor.

d) Check that a 1 ampere slow-blow type fuse is properly installed.

e) See that the alternating current is connected and properly grounded.

3.2 START-UP CHECKLIST

a) Attach a control cable to the Winchester plug at the rear of the unit.

b) Attach the motor control plug to the rear of the unit, as illustrated in figure 1c.

c) Make sure that a 1 ampere slow-blow fuse is in place.

d) Check that the motor leads are properly connected for correct polarity.

3.3 START-UP AND OPERATING PROCEDURE*

a) Move the LOCAL/OFF/REMOTE switch to the LOCAL position if no external interlock is used. Move to the REMOTE position if an external interlock is used. The RUNNING indicator should illuminate and the motor should start rotating.

*Refer to figures 1a-1c and to Section 5, "Troubleshooting," as needed.

3.3 (continued)

b) Turn the SPEED ADJUST control clockwise to increase the speed. Turn it counterclockwise to decrease the speed.

c) Put the FWD/REV switch in the REVERSE position and hold. The motor should reverse direction. Releasing the switch will return the motor to its normal forward rotation.

After the above checks have been satisfied, the unit is ready for normal operation.

SECTION 4

FUNCTIONAL ANALYSIS

In figure 2 (Speed Control Block Diagram), note that the motor control circuitry is riding on top of the motor. Thus, the firing angle of the power silicon controlled rectifier specifies the voltage level applied to the motor armature. Specific voltages yield specific motor shaft speeds.

The circuitry is discussed below under the headings: "Zener Reference," "Motor Control Circuit," and "Overload Current Limit," with reference to figure 2 and MC-4B schematic drawing 408-0894.

4.1 ZENER REFERENCE

The transformer secondary produces a voltage of 35 volts rms, 50/60 hertz. CR1 rectifies this to a half-wave and applies it to R1. The Zener reference (CR2) clips this halfwave voltage at the 9 volt level and supplies this squarewave reference voltage to the front panel SPEED ADJUST potentiometer (R3). The current path for CR2 is through CR1, R1, CR2, and back to the other side of the transformer secondary. Since the motor armature has low resistance on the order of 2.5 ohms, no significant voltage appears across the motor.

4.2 MOTOR CONTROL CIRCUIT

A portion of the Zener reference voltage is picked off by R3. This voltage is fed through a summing resistor (R4) to the input node of an amplifier consisting of Q1, CR3, and Q2. The output of the amplifier fires the unijunction transistor firing circuit (C2, R7, Q3, R8, and R9), which in turn fires the power silicon controlled rectifier (CR2), applying voltage to the motor.

If the motor does not begin to rotate, the circuit will continue to apply high voltage to the motor indefinitely, which would damage the motor severely if it were not for the overload current limit feature described in section 4.3.

If the motor does begin to rotate, a voltage proportional to the motor speed is derived by the motor speed feedback circuit, comprised of CR3, CR6, C4, Q4, and R13.

4.2 (continued)

This speed voltage is coupled into the same input node of the amplifier through the series-connected summing resistors R14 and R15.

A given reference voltage setting of potentiometer R3 specifies a motor speed corresponding to the firing angle of the CR2. If increased loading on the motor reduces its speed, the speed feedback voltage will decrease, driving the amplifier harder. This will advance the firing angle, thereby furnishing more voltage to the motor, which will thus maintain its speed independent of the increased loading.

4.3 OVERLOAD CURRENT LIMIT (Figure 3)

If the motor did not begin to rotate when speed was called for by the SPEED ADJUST potentiometer R3, the silicon controlled rectifier would phase full on because of the high gain of the amplifier. In this state, or with the application of more than rated torque by the motor, excessive armature current must be limited. There must, however, be a time delay before the overload limiting, since high inrush currents are desirable during initial start-up of the motor when it is under load.

The process works as follows. The motor armature current is sensed across the resistor R1. A voltage proportional to the peak armature current is rectified by CR8 and the information stored by C6. R19 provides C7 with a time-delayed version of this voltage. Q5 acts as an impedance transformer for this time-delayed voltage and applies it to potentiometer R21. A portion of this voltage is picked from the potentiometer wiper and is fed directly to the gate of the overload-current-limit silicon controlled rectifier (CR10). Depending on the position of the R21 wiper, the CR10 could be actuated at motor loads less than, equal to, or greater than the rated load.

When CR10 fires, CR2 is shorted out by the shunting current through CR11 and the conducting CR10, thus disabling the motor-speed-control firing circuit and preventing the power silicon controlled rectifier (CR2) from firing. Simultaneously, capacitor C10 impresses voltage to relay K1, R22, and CR10, holding CR10 on. This, in turn, holds the contacts of K1

4.3 (continued)

closed and lights the OVERLOAD indicator (DS2). In this condition the current to the motor is zero, as the power silicon controlled rectifier CR2 stops all current flow. The motor cannot be operated again until CR10 ceases conducting and recovers. CR10 is reset by turning off the input power source by throwing the LOCAL/OFF/REMOTE switch (S2) to the OFF position and waiting a few seconds before again throwing the switch to the LOCAL or REMOTE position to restart the motor.

SECTION 5

TROUBLESHOOTING

Symptom	Possible Cause	Remedy
Unit will not turn on when power switch is thrown.	No input power to plug at rear of unit.	Check that line power is present.
		Check to see that wires are connected properly to pins in plug; fix as needed.
		Check for short or open in the cable; fix as needed.
	Line fuse burned out.	Replace line fuse. If fuse flows again, see possible causes listed below.
	Primary or secondary transformer winding appears to be shorted.	If primary or secondary windings are shorted, replace transformer. If not, see below.
		Check whether external equipment is shorted at the windings; repair short as needed.
		Check motor field winding for a short circuit; repair or replace the motor as needed.
	CR2 is bad.	Replace CR2.
	CR1 or CR3 is shorted.	Replace as necessary.
	CR1 or CR3 is shorted at binding posts on the printed circuit board.	Repair the short on the binding posts.
	Connectors on the printed circuit board are shorted.	Find and repair the short.
	Shorted wires on the printed board.	Find and repair the short.

NOTE: Refer to drawings 408-0894 and 408-0903.

Section 5 (continued)

Symptom	Possible Cause	Remedy
Motor will not start.	Motor leads open.	Replace open leads.
	Clipped halfwave voltage (squarewave) of 9 volt, P-P 60 Hz, not present across CR2 with R3 full counter-clockwise.	CR2, Q2, Q3, or R3 shorted. Replace the shorted component.
	Squarewave is not reaching R3 wiper.	Transistor Q1 bad, replace.
		CR3 is open, replace.
	No voltage drop across R5 with the oscilloscope connected across it and R3 full clockwise.	Replace R5.
	With oscilloscope, sawtooth waveform not present across R9.	Replace Q3 or Q2
	No positive going pulses across R9.	Q3 not firing, replace.
	CR2 not firing (check with oscilloscope across CR4).	Replace CR2.
	CR1 or CR3 open.	Replace bad component.
	Open armature winding.	Replace armature or motor.
No motor speed regulation.	CR3 shorted.	Replace.
	CR6 open or shorted.	Replace.
	Q4 not operating.	Replace.
	C4 shorted.	Replace.
	R14 open.	Replace.
	Collector of Q4 does not have +6 to +10 volt dc.	If CR7 is open, replace.

Section 5 (continued)

Symptom	Possible Cause	Remedy
Overload indicator does not illuminate when overload occurs.	Indicator light (DS2) burned out.	Replace DS2.
	Relay K1-1 not operating.	Repair or replace K1-1.
	R21 not properly adjusted.	Adjust R21.
	CR8 open.	Replace.
	Voltage across C6 does not rise slowly as torque is applied.	C6 shorted; replace.
	Voltage across C7 does not rise slowly as torque is applied.	C7 shorted; replace.
	Q5 bad.	Replace.
	Voltage across C8 does not increase with torque.	C8 shorted; replace.
	Voltage across C9 does not increase with torque.	C9 shorted; replace.
	No 115 volt dc on C1	Check CR1 for open.
	Open circuit between CR11, R22, K1, CR10, and CR3.	Identify and replace defective component.
Constant overload condition.	Frozen or dirty load guides.	If the motor draws a no-load of 90 mA, check the current during slippage. Decrease should not exceed 190 mA. If it does, check the load for hang-ups such as frozen or dirty guides.
	Motor draws a no-load of more than 90 mA.	Replace the motor. Check the controller logic. See section 4, "Functional Analysis."

SECTION 6

CALIBRATION PROCEDURE

Normally, it would not be necessary to calibrate this instrument. The calibration procedure is described below, however, in case parts are damaged accidentally.

6.1 REQUIREMENTS

a) Drawings: 408-0894, 408-0903, and 408-0912.

b) Cathode-ray oscilloscope.

c) Volt-ohm milliammeter.

d) Direct current motor: Bodine No. B2150E-18.

e) 2,000 rpm mechanical tachometer or stopwatch.

6.2 ADJUSTMENT PRIOR TO POWER APPLICATION

a) Using a screwdriver, turn R21 full counterclockwise. (In this position the overload trip mechanism is in the most sensitive setting. It therefore may kick out too easily and require readjustment in the test procedure, section 6.3.)

b) Using a screwdriver, turn R2 (minimum speed adjust) fully clockwise as viewed from the rear.

c) Using a screwdriver, turn R3 (front panel SPEED ADJUST) fully counterclockwise.

d) Turn R14 (maximum speed adjust) to midrange.

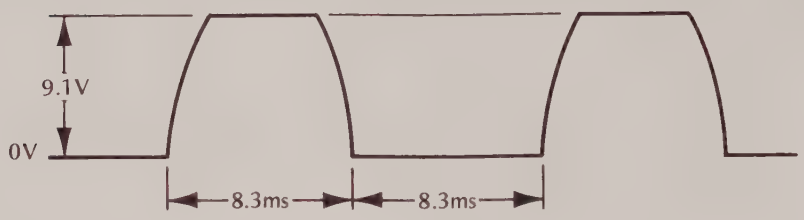
e) Connect the motor to J2 through P2: blue leads (armature) and black leads (field).

6.3 TEST PROCEDURE

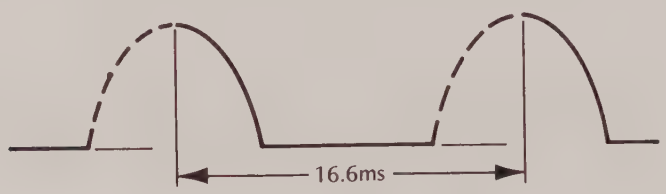
a) Apply 115 volts ac and turn on S1.

6.3 (continued)

b) Use the oscilloscope to probe the junction of R1 and R2 and the ground at the cathode of CR10. A chopped half-cycle sine wave with a 9.1 volt amplitude and approximately 16.6 milliseconds separation should appear.



c) Place the oscilloscope across R1 and vary the front panel SPEED ADJUST potentiometer (R3). The motor should run, and the following waveform should appear.



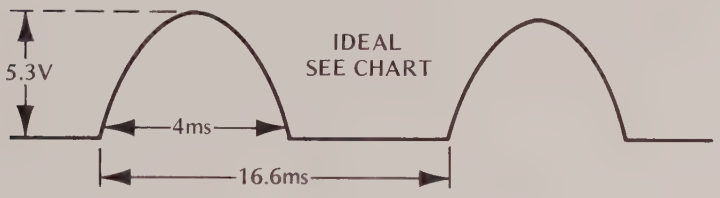
d) Turn the front panel SPEED ADJUST potentiometer (R3) fully counterclockwise and adjust R2 until the motor speed is about 30% of the rated speed by applying the tachometer to the high-speed shaft. The low-speed shaft is 29 rpm. Measure the revolutions per minute with the tachometer.

e) Turn the speed control CR3 to midrange and adjust R14 until some control by R15 is noticed. Adjust speed control R3 fully clockwise, apply the tachometer to the high-speed end of the motor, and adjust R14 for 100% of rated speed. The low-speed shaft should be at 30% of rated speed.

f) The speed control R3 should vary the motor speed from 521 rpm (counterclockwise) to 1725 rpm (clockwise). If not, repeat steps d and e. If this range is unattainable with R3, adjust R25 to remedy. The value for R25 is 12K to remedy a high-speed range and 22K to remedy a low-speed range.

6.3 (continued)

g) Hook up a milliammeter in the armature circuit. Apply a lead to either end of the motor and adjust R2 until it trips at 250 milliamperes. There will be a few seconds time delay before the overload trip responds. Reset by turning the MC-4B off and then back on again.



CAUTION

See figure 3 voltage/time graph for safe-zone operation.

h) Place the cover on the unit.

SECTION 7

PARTS LIST AND RECOMMENDED SPARE PARTS

7.1 PARTS, MAIN ASSEMBLY

Designation*	Qty	Description	Manufacturer	Manufacturer's Part No.	Airco Temescal Part No.
	1	front panel fab.			0411-9993-2
	1	chassis fab.			0410-1884-0
	1	cover fab.			0407-8914-0
	1	relay bracket fab.			0307-1742-0
	1	SCR speed control printed circuit board assembly			0408-0900-0
F1	1	fuse, 1 ampere, 125 volt ac Slo-Blo, 3Ag	Littelfuse	313001	6056-3089-0
R3	1	potentiometer, 500 ohms, 2 Watts	International Rectifier	WPRL	6046-5827-0
T1	1	transformer			0306-2041-0
XF1	1	fuseholder	Littelfuse	342004	6056-3004-0
for R3	1	potentiometer adapter	H.H. Smith	2351	6047-4701-6
item 9	1	nut dress-up			0306-2771-0
	9	speed nut	Tinnerman	C6452-6Z-24	1270-1206-0
	4	screw mach., oval-head Phillips, 6/32 x 3/8 inch			1255-5412-0
	12	nut, 6/32 inch	Keps		1258-1201-0
	16	screw mach. pan head, 6/32 x 3/8 inch			1240-1254-0

*Reference main assembly drawing 505-0193.

7.1 (continued)

Designation*	Qty	Description	Manufacturer	Manufacturer's Part No.	Airco Temescal Part No.
P1	1	connecting (F) cable assembly, 14-pin			0307-9031-0
	1	SCR mounting board assembly			0408-0910-0
item 36	2	dress nut	Fisher	XX44137	6950-4413-7
K1	1	relay, 24 volts, dc	Potter & Brumfield	KHP17D11	6041-7677-0
XK1	1	relay socket	Potter & Brumfield	9KH1	6041-5940-0
J1	1	jack	Winchester	MRAC-14P	6047-0882-0
J2	1	jack motor	C-J	S304AB	6047-8045-0
item 29	9	contact pin (M)	Winchester	100-0915P	6047-8026-1
item 29	1	guide pin set	Winchester	G-700	6047-8700-0
S1	1	switch, toggle, 2-pole, 3-throw, ON/OFF/ON	C-H	7591K6	6156-3050-0
DS1	1	lens, RUNNING			0307-2252-1
DS2	1	lens, OVERLOAD			0307-2252-2
S2	1	switch, toggle, 2-pole, 2-throw, momentary, ON-(OFF)	C-H	7595K6	6156-4721-0

*Reference schematic drawing 0408-0894-D.

7.1 (continued)

Designation*	Qty	Description	Manufacturer	Manufacturer's Part No.	Airco Temescal Part No.
P2	1	connector mate	C-J	P304CCT	6047-0804-0
	2	vertical card guide, 1250 volt	SAE		6643-1250-0
	1	connector, 15-pin	Amphenol	143-015-01-110	6047-0500-0
CR1	1	rectifier bridge, 18DB, 6 amperes			6842-8193-0
R1	1	resistor, 7,000 ohms, 10 Watts			6423-1751-0
	2	spring clips	Ohmite	#5	6475-5894-0
	6	stand-offs, insulated	Useco	1417	6047-3630-0
C1	1	capacitor, 40mF, 150 volts	TVA	1413	6510-0176-0
	1	screw, 6/32 x 1/2 inch, nylon			1042-1255-0
	1	nut, 6/32 inch, nylon			1060-1201-0
	1	resistor, 560,000, 0.5 Watt, 5%			6405-4715-0

*Reference schematic drawing 0408-0894.

7.2 RECOMMENDED SPARE PARTS

	Airco Temescal Part No.	Qty
Transistor, 2N3906	6823-9060-0	2
Transistor, 2N3904	6823-9040-0	1
Unijunction transistor, 2N2646	6822-6460-0	1
Zener Diode, 1N4739	4735-7390-1	1
Zener Diode, 1N4735	4739-7350-2	1
Diode, International Rectifier, 10D8	6838-9410-0	2
SCR, 2N4444	6824-4440-0	1
SCR, General Electric, 106A1	6840-9106-1	1
Fuses, 3Ag, 1 ampere, Slo-Blo	6056-3089-0	5

SECTION 8

FIGURES AND DRAWINGS

Figure 1a. MC-4B front view

Figure 1b. MC-4B rear view

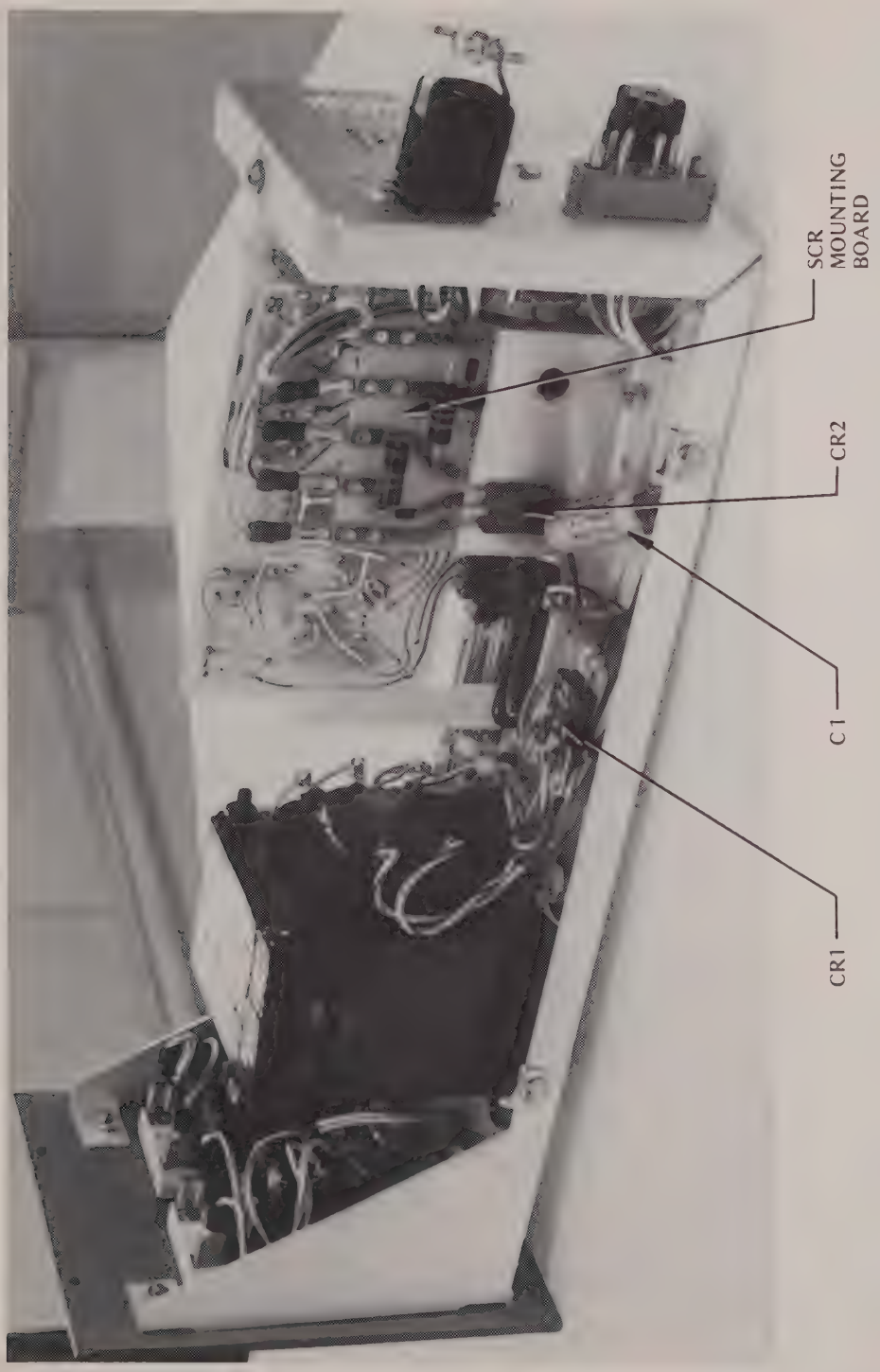


Figure 1c. MC-4B side view showing printed circuit boards

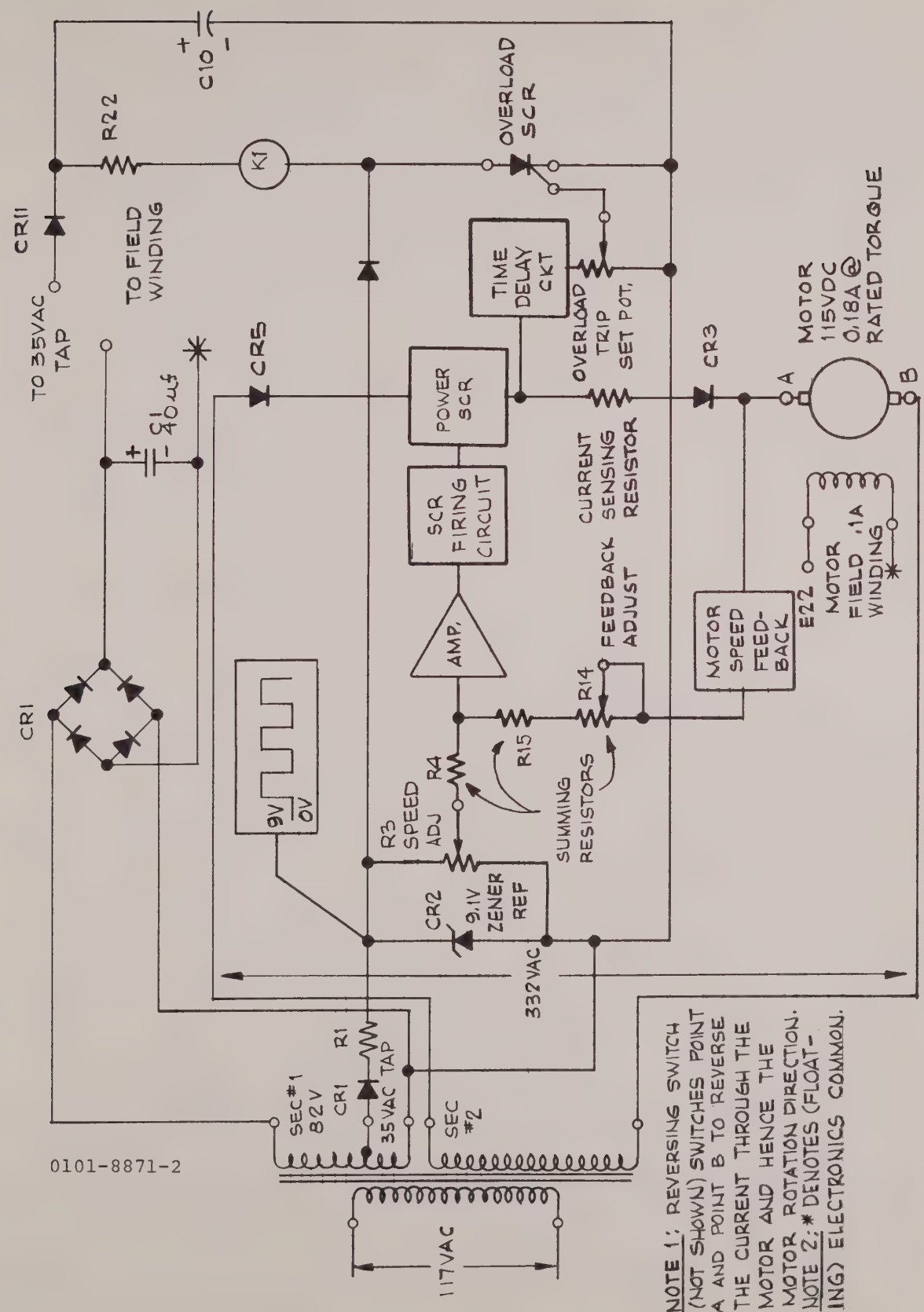


FIGURE 2-MC-4B SCR SPEED CONTROL BLOCK DIAGRAM

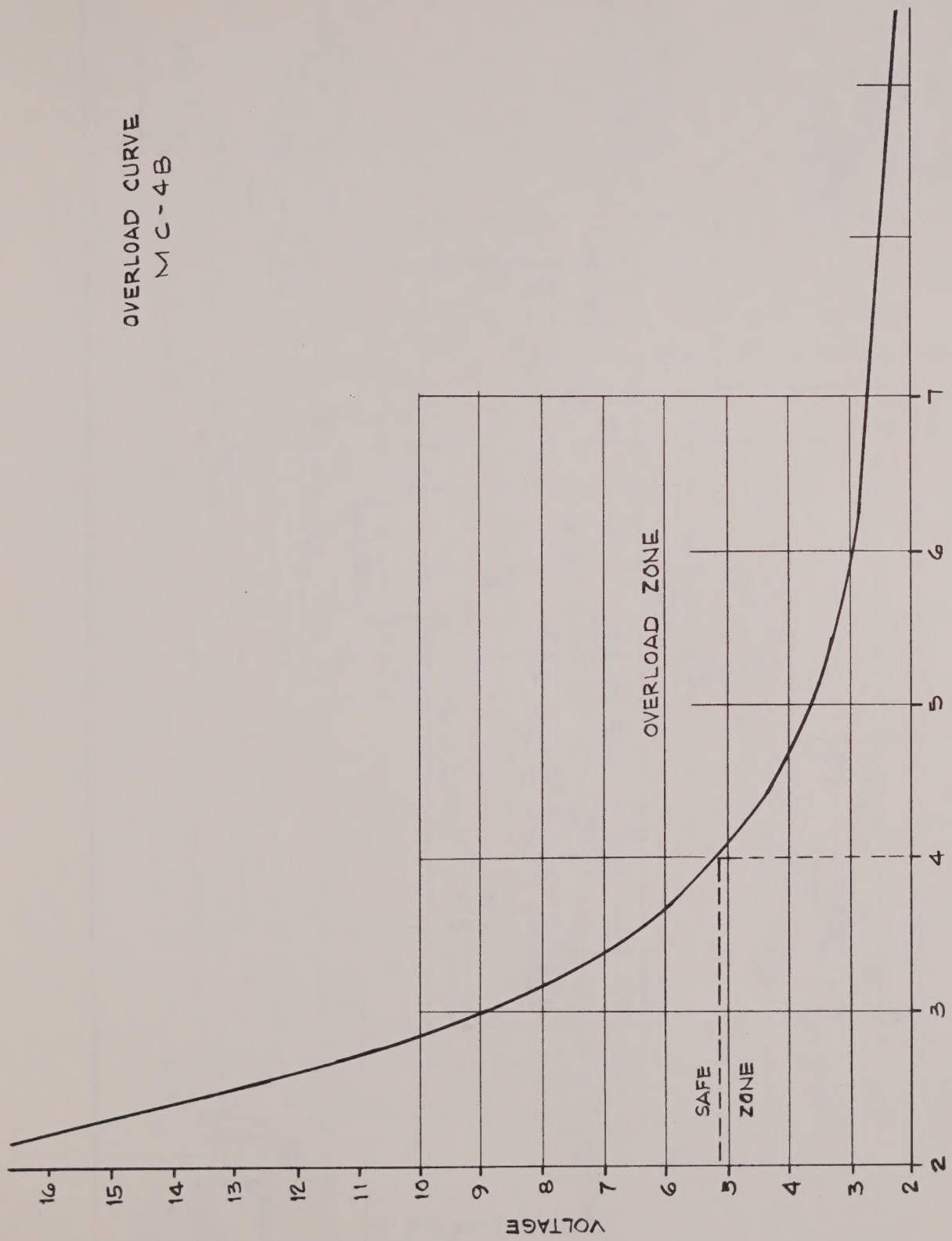
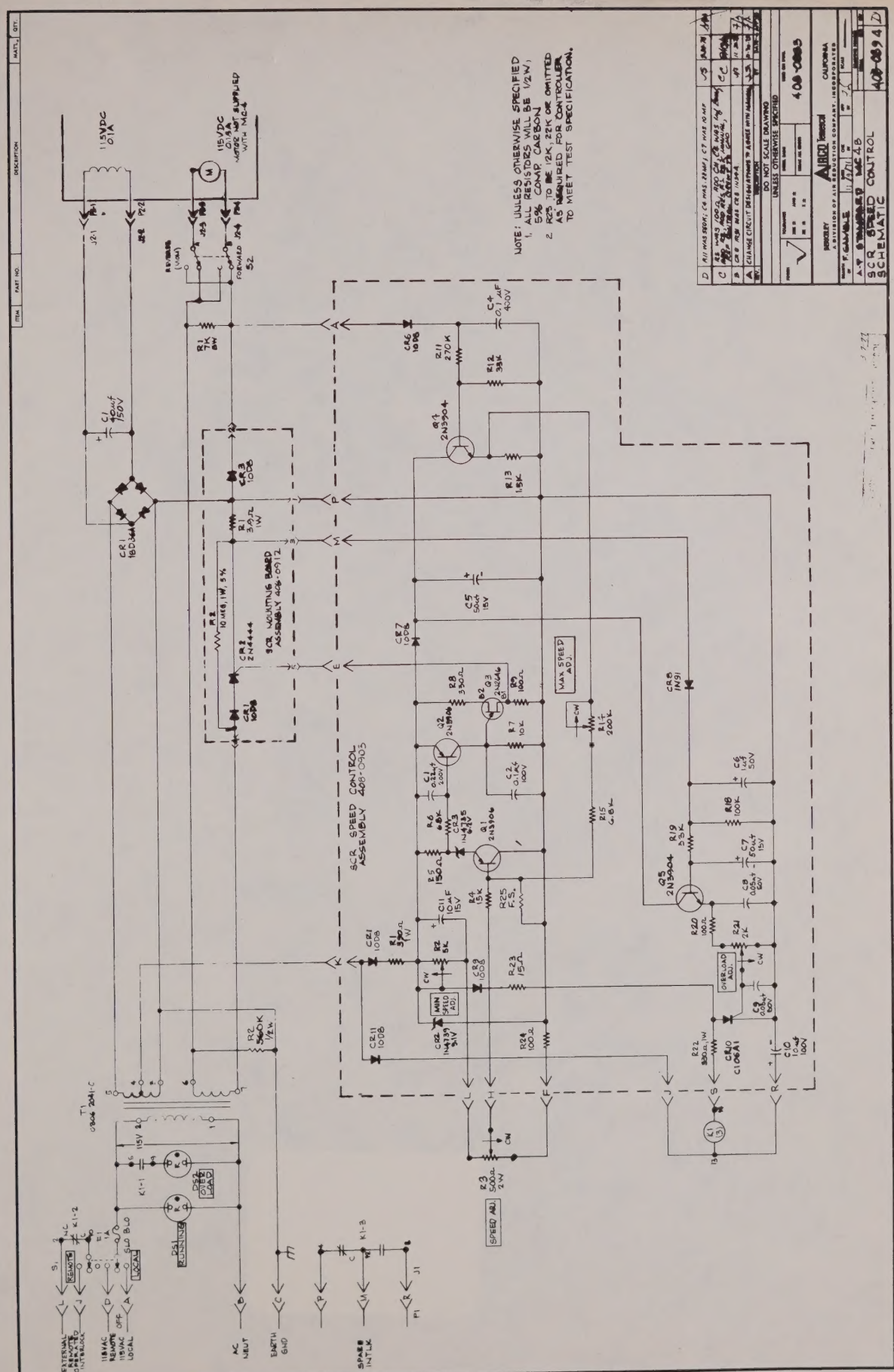


FIGURE 3-TIME IN MILLISECONDS


SCR SPEED CONTROL
ASSEMBLY 408-0905
SCR MOUNTING BOARD
ASSEMBLY 408-0912
NOTE: UNLESS OTHERWISE SPECIFIED
1. ALL RESISTORS WILL BE 1/2W)
ALL 5% COMP. CARBON
2. R23 TO BE 12K, 22K OR OMITTED
AS REQUIRED FOR CONTROLLER
TO MEET TEST SPECIFICATION.
MAX SPEED ADJ.
MIN SPEED ADJ.
OVER LOAD ADJ.
SPEED ADJ.
SPEED INTLK
AC INPUT
EARTH GND
115VAC REMOTE
115VAC LOCAL
EXTERNAL REMOTE OPERATED INTERLOCK
OFF
RUNNING
OVER LOAD
SCR SPEED CONTROL
SCHEMATIC
MC4B
408-0894
AIRCO Temescal
BERKELEY
CALIFORNIA

MP MASTER
MA32752